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Entered in the post-office at Lancaster, Pa., as second class matter

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

SUB-STATION 84: NEW YORK

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PHYSICAL CHEMISTRY IN THE SERVICE OF PHYTOGEOGRAPHY[1]

BIOLOGISTS, grown in the present generation from a mere squad of determined scouts to a splendid army of disciplined investigators, increasing daily in rank and equipment, have as their greatest task the placing of biology alongside physics and chemistry in the ranks of the exact sciences.

In the title of this paper, *Phytogeography,* which even its most ardent disciples must confess is one of the least quantitative of the biological sciences, is coupled with *Physical Chemistry,* which is conceded by all to be one of the most precise of the physical sciences. This contrast has been made, not to magnify the chasm which conventionally has been assumed to separate the exact from the descriptive sciences, but to emphasize to biologists and to chemists and to physicists alike, the fact that the methods of the most advanced physical sciences can now be successfully employed in such a confessedly descriptive phase of biology as ecology and phytogeography.

In turning to the task of the moment, which is to consider how certain of the simplest physico-chemical methods may be of service in ecology and phytogeography, it is important to place the group of problems to be investigated in its proper biological setting, and to state these problems in such a form that their relationship to a physico-chemical method of investigation is quite obvious.

[1] A paper presented at the Symposium on Relations of Chemistry to Botany, before the joint session of Section G, American Association for the Advancement of Science, and the Botanical Society of America, December 27, 1916.

Phytogeography has two main phases, the historical and the physiological.

In the investigation of the historical factors involved in the geographical distribution of plants, the methods of physical chemistry can be of little service.

The physiological problems of ecology and phytogeography are essentially those of the relation of the organism to its environment. It is here that physical chemistry, along with other quantitative and experimental methods of research may be profitably applied.

It is a truism to say that the relations of the living protoplasm to its inert environment constitutes one of the most fundamental groups of biological problems. To cooperate in the solution of these problems is the greatest opportunity of ecologists. That the contribution of ecology has not already been greater is largely attributable to the non-quantitative character of most of the work hitherto done.

In the closer analysis of the relationship of the organism to its surroundings it is apparent that there are two planes of contact of protoplast and environment: that which lies between the protoplast and separates it from the outside world, and that which lines the vacuoles of the cell and separates the deeper-lying protoplasm from the internal environment of the vacuolar solution, just as the plasma membrane separates it from the external world.

The processes which are taking place in these two planes are presumably physicochemical processes. Certainly, physicochemical methods of investigation are those which may be applied with the greatest hope of advance in the solution of the problems presented by those planes of contact of organism and environment.

That these processes are of fundamental significance to the student of the complex problems of ecology and phytogeography of the higher plants should be evident from the fact that the differentiation of tissues in the vast majority of flowering plants, with which alone I am concerned in this paper, is such that the cell membrane comes into contact with two quite distinct phases of the environment. In water absorption, it separates the fluids of the cell from a soil solution of quite different properties. In water loss, it separates the fluids of another set of cells from an atmosphere varying enormously in its water absorbing capacity.

These two environmental factors, which stated in physiological terms may be referred to as the force with which the substratum withholds water from the plant and the force with which the atmosphere tends to withdraw water from the plant, have by common consent been given the place of first importance in the environmental complex.

The importance of a thoroughgoing investigation of the relationship of the plasma membrane to the concentration and the composition of the intracellular and the extracellular solution has long been recognized. Nor have physiologists interested in the problem of transpiration failed to recognize the fundamental significance of the membrane which separates the fluid contents of the cell from its gaseous environment.

It is quite natural that the problem of the permeability of the cell membrane should have been far more extensively investigated than that of the relationship of the protoplast to the cell sap. Experimental modification of the solution surrounding the cell is subject to only the limitations imposed by the solubilities and other properties of chemical reagents and the viability under the influence of these reagents of the cells or tissues employed. To determine the properties of the sap con-

tained in the vacuole at any moment is a problem of some difficulty, to modify these properties at will is in itself an undertaking of no mean magnitude, while to investigate with any degree of completeness the relations of the properties of the sap of the vacuoles to the surrounding protoplasm would seem to be a task of almost unsurmountable difficulties.

Nevertheless, the time has come when an investigation of the properties of the sap of the vacuole in relation to the protoplast and in relation to the factors of the environment should be undertaken. It is inconceivable that the properties of the sap should be uninfluenced by the forces which are acting upon and through the living membrane surrounding the cell. It is difficult to think, for example, that the osmotic properties of the sap of the vacuoles should be independent of the forces which are tending to draw water from the cell in transpiration and of the forces in the substratum which oppose water absorption. If this be true, an investigation of the properties of the intracellular fluids of plants in various environments, in which the water-absorbing power of the air as well as the water-yielding capacity of the soil vary enormously, may throw much light upon the basic physiological problems of ecology and plant distribution.

If progress is to be made, it is not merely necessary that problems be clearly defined, but that methods which are adequate and practical for use under the conditions surrounding the investigation shall be found. The question of method becomes, therefore, one of paramount importance.

The phytogeographer must limit his choice to those methods which can be used under camp conditions. Otherwise he must be willing to forego work on phytogeography in the only regions in which it can be satisfactorily investigated, that is, in those which have not been completely modified by the activities of man. Fortunately the determination of the depression of the freezing-point of a solution below that of the pure solvent furnishes a relatively simple method of calculating its osmotic pressure or osmotic concentration. It is quite possible to make cryoscopic determinations sufficiently exact for phytogeographical problems in the field, and especially at the field laboratories which fortunately are becoming more numerous.

In addition to developing a simple technique for use in the field, one who hopes to convince botanists that the investigation of the physico-chemical properties of vegetable saps should form an essential part of a comprehensive ecological or phytogeographical study, must show that in any region the sub-habitats, formations, associations, plant societies or whatever the nomenclatorial specialist may call them, are measurably different in their sap properties, and that even more conspicuous differentiation exists in the sap properties of the larger phytogeographical regions. If he can also show that such ecological groups as the succulents, the epiphytes and the parasites are differentiated in the physico-chemical properties of their tissue fluids, the necessity for the use of physico-chemical methods in phytogeographical work will be self-evident.

The foregoing outline of the fundamental conceptions underlying the studies which my associates and I have carried out in various regions has of necessity been so detailed that it will be impossible at this time to give any adequate summary of the many hundreds of determinations of osmotic concentration of tissue fluids of plants growing in various environments which are now at my disposal.

The actual details, as far as published, are available in a series of technical papers.

How great the differences in the sap properties of the vegetations of various regions may be is illustrated by the accompanying table in which the average concentration in atmospheres for Long Island, Arizona and Jamaican regions studied by my associates and myself and for a series of determinations made for a quite different purpose by Ohlweiler at the Missouri Botanical Garden are laid side by side.

Region	Ligneous Plants	Herbaceous Plants
Montane rain forest:		
Blue Mountains, Jamaica...	11.44	8.80
Mesophytic regions:		
Long Island habitats	14.40	10.41
Missouri Botanical Garden.	14.96	——
Desert regions:		
Jamaican coastal deserts ...	30.05	——
Arizona deserts	24.97	15.15

Had it been possible to table the data of each of these regions, and that for others which are now available, according to local habitats it would have been seen that in any region the local habitats may be measurably differentiated with respect to the sap properties of their vegetation. Tabulation by local habitats would also have brought out clearly the fact that herbaceous and ligneous plants differ in the osmotic properties of their tissue fluids.

The averages in the table are not presented as complete descriptions of the sap of the plants of these regions, but merely as the simplest available means of summarizing their characteristics and emphasizing to the phytogeographer the fact that the vegetations are differentiated in the properties of their sap as well as in their taxonomic composition and ecological structure.

The explanation of such differences in vegetations as have just been demonstrated is by no means simple.

The most direct and obvious relationship of the properties of the sap of the organism to its environment is to be seen in halophytes. The leaves of many of these are salty to the taste. It is quite apparent that they must have a relatively high concentration due to the absorption of salts from the substratum. It is, however, a grave error to assume, as some botanists seem to have done, that the whole problem of sap concentration is one of the absorption of electrolytes from the soil—to assume in fact, that the plant organism stands in the relation of a sponge to the solution around it. Zoologists, who have devoted much attention to the relationship between the concentration of the blood of the marine organisms and that of the water in which they live, have long recognized that the osmotic concentrations of the two fluids may be identical but that the solutes to which these concentrations are due may be very different indeed.

Even in the succulent halophytes, the leaves of which are essentially reinforced water bags, there appears to be by no means an identical capacity for adjustment to the concentration of their substratum or for the occupation of available areas. Thus, for example, *Sesuvium Portulacastrum* and *Batis maritima* both occur on the highly saline flats of the southern shore of the island of Jamaica. *Batis* shows a far higher osmotic concentration than *Sesuvium*, 49.7 as compared with 38.3 atmospheres on the average, and is seen in the obviously more saline localities.

Now differences in the concentration of the soil solution may not be the determining factor in the distribution of these two halophytes. Other factors require far more detailed investigation than any one has been able up to the present time to give them. The point to be emphasized here is that two species of halophytes, not without several points of similarity, differ in both sap concentration and in local distribution. The chemical method has given

us at once measures of the physiological characteristics of these two forms. These quantitative measures furnish a first definite step towards the solution of the problem of their distribution.

To discuss adequately the many problems presented by a comparison of the sap properties of the vegetations of diverse local habitats or phytogeographical regions would carry us far beyond the limits of this address. Before leaving this phase of the subject it is important to point out that in its relationship to plant distribution, sap concentration may have a dynamic as well as a static significance.

If the differences in the sap properties of the vegetations of various habitats be in part due to fixed hereditary differences in the species, instead of merely a resultant of local environmental conditions, and if one of the factors determining the capacity for survival in a given habitat be the osmotic concentration of the cell sap, it is clear that sap properties may be a factor in the migration of species.

The factor of osmotic concentration would be active in two ways. First, in the determination of migration from warmer into colder regions, by virtue of capacity for frost resistance. Second, in migration from mesophytic into desert regions.

The problem of the relationship of sap concentration to frost resistance need not delay us long. The freezing-point of plant tissues has been the subject of scores of investigations, most of which have been of a purely physiological or of an economic nature.

The studies of Ohlweiler, Chandler and others render it highly probable that the osmotic concentration of the tissue fluids is one of the factors involved in the capacity for frost resistance. Such determinations as Mr. Popenoe and I have been able to make on the sap of the varieties of avocado (*Persea americana*) which have been introduced into the United States, indicate that the Mexican and Guatamalan types, which have been found by practical horticulturists to surpass the so-called West Indian type in capacity for frost resistance, have a slightly higher osmotic concentration of their cell sap.

Concerning the rôle of osmotic concentration in the survival of plants introduced into xerophytic regions we have as yet practically no information.

It is perhaps evident that the factors which limit the artificial introduction of species would also be active in determining the survival of species introduced into any region by hurricanes, ocean currents or by any other natural causes. Upon some of these questions I hope to be able to furnish more satisfactory information on a later occasion.

We must now turn to a discussion of certain of the ecologically more interesting groups of plants. Among these may be mentioned the succulents, the epiphytes and parasitic plants.

The studies of succulent physiology which have been carried out in recent years, and especially at the Desert Laboratory by MacDougal, Spoehr, Richards, Mrs. Shreve and others, have been far too detailed to make possible any adequate discussion of succulency at this time. It is interesting to note in passing that the succulents are characterized by two quite different types of sap. On the one hand are the desert species with generally low osmotic concentration, on the other the halophytes with high osmotic concentration. The physiological interpretation of this condition presents a most interesting problem for future research.

Among the most characteristic, and ecologically most fascinating features of tropical regions is the burden of epiphytes

borne by the trees. If one turns to the literature in search of work of a quantitative nature on the physiology of this taxonomically and morphologically diversified group of plants, his search will be practically in vain. Material progress has already been made in the study of the sap properties of some of the representative types, although it is quite too early to discuss in detail even this phase of the physiology of these plants.

Osmotic concentration in these forms is generally exceedingly low, Orchidaceæ from the Jamaican rain forest show an average of 3.34 atmospheres, those from the Florida hammocks an average of 4.88 atmospheres. Tank epiphytes from the Blue Mountains of Jamaica show concentrations ranging from 2.8 to 5.5 atmospheres. Comparable values are found in subtropical Florida.

The succulent Peperomias and some other epiphytic species are also characterized by a concentration of their tissue fluids only a fraction of that obtaining in the foliage of the arborescent plants of the same forests.

Thus, in general, epiphytic species are characterized by low osmotic concentration. This is not, however, a necessary condition of epiphytism. Determinations are available for at least one species of epiphytic fern showing a sap concentration roughly three times as high as that generally characteristic of the succulent Orchidaceæ and Piperaceæ and the tank Bromeliaceæ.

The keen botanical interest aroused by parasitic flowering plants has found expression in an enormous number of macroscopic and microscopic morphological and life-history investigations. Yet it should be clear that the problem of the distribution of parasitic forms, both among the possible host plants of a particular region and from region to region, is primarily a physiological one. Among the possible factors, the relative concentration of the tissue fluids of the photosynthetic and transpiring organs of the host and parasite seems on *a priori* grounds one of the greatest importance. Studies on the osmotic concentration of the tissue fluids of Jamaican Loranthaceæ on various hosts have shown that in general but not invariably, the osmotic concentration of the fluids of the leaves, or of the leaf homologs, of the parasite is higher than that of those of the host.

In the foregoing discussion only a portion of the results of studies already made, but as yet largely unpublished, have been lightly touched upon. They are illustrative merely. For the mass of facts justifying generalization, the published tables must be consulted. Enough has, perhaps, been said to indicate the fundamental significance for the physiological phases of phytogeography of the physico-chemical measurements. As phytogeography becomes more and more a problem of the physiology of individual species of plants, investigated in their own environment, as methods become more precise, and as results are recorded and discussed in more quantitative terms, the ecologist's sector of the attack upon the great problem of the relationship of the organism to its environment will be increasingly successful. Concurrently, the relations of chemistry to botany will become more clearly defined in a field in which its existence has heretofore been little recognized, and the service of chemistry to botany will be increasingly great.

J. Arthur Harris

SCIENTIFIC EVENTS

MEMORIAL TO SIR WILLIAM RAMSAY

The following appeal has been issued by a committee formed to raise a memorial to the late Sir William Ramsay.

A committee has been formed with the object of raising a suitable memorial to the late Professor Sir William Ramsay, K.C.B., F.R.S., by collecting a substantial fund to be utilized for the purpose of promoting chemical teaching and research.

The committee, after prolonged and careful consideration, has resolved to aim at raising a sum of £100,000, and to devote that sum to two principal objects, viz.:

1. The provision of Ramsay research fellowships, tenable wherever the necessary equipment may be found.

2. The establishment of a Ramsay Memorial Laboratory of Engineering Chemistry in connection with University College, London.

We should hesitate to ask for so large a sum of money in such exceptionally difficult times, were it not that the objects specified are objects of real and urgent national importance. The war has demonstrated in a manner previously unrealized the supreme importance of scientific, and, in particular chemical, research to the national life, both in the conduct of the war and in the pursuits of industry and manufacture.

The late Sir William Ramsay was himself engaged up to within a comparatively short time of his death in various important problems concerned with the bearing of chemistry upon the war, and no one realized more completely than he the potentialities of the plans which have since been formulated by this committee as a memorial to him.

It is important that the fund should be raised speedily, so that the plans for the laboratory of engineering chemistry and the scheme for the award of fellowships may be prepared before the end of the war, and so that both schemes may begin to operate with as little delay as possible after the return of peace.

Accordingly, we desire, through the columns of your paper, to appeal to friends and admirers of the late Sir William Ramsay, to old students, and to all persons who are interested in chemistry and its application to industry and manufacture, to contribute to this great national and international memorial to the late Sir William Ramsay, and to send their subscriptions to the honorable treasurers of the Ramsay Memorial Fund at University College, London, W.C.1.

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It is stated in *Nature* that the sum already subscribed by Ramsay's friends, and through their private efforts, amounts to more than £14,000. This includes the generous gift of £5,000 from Messrs. Brunner, Mond, Ltd.; £1,000 each from Lord Glenconner, Sir Hugh Bell, Sir Ralph C. Forster, Sir Robert Hadfield, Mr. Robert Mond, and Mr. J. B. Noble; and £500 each from the president of the British Science Guild (Sir William Mather), Mr. Charles Hawksley, and Miss Lilias Noble.

A memorial tablet, including a medallion portrait of Ramsay, is to be erected in the University of Glasgow, of which he was a graduate and teacher. The University Court has arranged that the memorial, which is designed by Sir John J. Burnet, shall be placed in a conspicuous position at the entrance to the Bute Hall.

SMITHSONIAN BOTANICAL EXPEDITIONS

A RECENT pamphlet on the field-work conducted by and for the Smithsonian Institution states that, while carrying on botanical explorations in Venezuela last fall, Dr. J. N. Rose, associate curator of plants in the National Museum, secured some interesting specimens of "sabadilla," a Venezuelan plant of the lily family, from the seeds of which are produced some of the asphyxiating and tear-producing gases used in the present war.

The specimens were secured by Dr. Rose through the cooperation of Consul Homer Brett, La Guaira, Venezuela, who stated in a report of the Department of Commerce, some time ago, that this plant is known locally as "cevadilla," a diminutive of the Spanish word "cebada," meaning barley, and occurs in Venezuela and Mexico. Its highly poisonous seeds have long been used in medicine. The substances produced from sabadilla seed are cavadine, or crystallized veratrin, an alkaloid; veratric acid, and sabadilline, a heart stimulant.

Neither the consular report nor the Smithsonian pamphlet gives the formula for the manufacture of the war gases, but it is stated

in the former that the dust from the seed in the field irritated the eyes, throat, and especially the nose, so much that the native laborers were obliged to wear masks. It has been reported that the Germans had bought all the available supply of these seeds before the declaration of war. Both the sabadilla seeds and all preparations compounded from them are now, however, declared contraband by England.

Another plant of the same genus grows wild in Texas, and some botanists believe that should a need for sabadilla arise here it could easily be cultivated in Texas and in other southern states. Dr. Rose collected many other specimens during his trip, primarily in the mountains about Caracas and Puerto Cabello, where he made an especial search for cacti and orchids.

Mr. Paul C. Standley, another botanist of the National Museum, spent three weeks in the vicinity of Fort Myers, on the west coast of southern Florida, collecting plants and studying the local flora. He was later detailed for field-work in New Mexico, and remained for four weeks at Ute Park, where he gathered over 5,000 specimens, including several genera new to the state, and many additional species. During his work, he secured the largest collection of cryptogams, the flowerless plants propagated by spores or simple cell division, ever obtained in New Mexico. This collection includes about 300 species of fungi not previously found in this state.

The Smithsonian pamphlet also describes the botanical explorations of Professor A. S. Hitchcock in the Hawaiian Islands, a report of which will be published shortly.

WAR SERVICE FOR CHEMISTS[1]

Chemists and chemical engineers are normally needed in almost all branches of industry (including the standardization and control of food products) for the successful operation of processes, the detection and speedy correction of difficulties and the improvement of products. England, France and Italy found it necessary to recall all chemists from the ranks; Canada does not allow chemists to enlist; chemists have saved Germany up to the present time.

There was a decided shortage in the supply of chemists in the United States even before April, 1914. The war has made the shortage acute, and it is certain that our own war needs and industries necessary to war will absorb chemists as rapidly as they can be trained.

It takes from four to seven years to train a chemist. The shorter time is for college graduates and chemical engineers who become wholly useful only after a further year of experience in a manufacturing plant or laboratory (corresponding to the hospital year required of medical students). The longer time is for the training of research men taking the doctorate degree in chemistry, on whose shoulders ultimately the vast need of the government and the industries fall for meeting and solving new difficulties and problems of organized research.

When chemists of mature years are called in for service in government laboratories, their places must be filled by younger men to keep the machinery working. It is, therefore, of the greatest importance that steps be taken:

1. To keep and impress into service *in chemical* lines chemists drawn by the draft for service in the United States Army or Navy.

2. To provide means for keeping open sources of supply of chemists from universities, colleges, and schools of technology, and to procure volunteers in chemistry.

A tentative plan for accomplishing these results is hereby appended and recommended.

William H. Nichols, *chairman of the Chemistry Committee, National Defense Council.* Past-president, Society of Chemical Industry. President, Eighth International Congress of Applied Chemistry.

Marston T. Bogert, *chairman of the Chemistry Committee, National Research Council.* Past-president, American Chemical Society.

[1] Report to the Council of National Defense.

A. A. NOYES, *Past-president, American Chemical Society.*

JULIUS STIEGLITZ, *President, American Chemical Society.*

CHARLES L. PARSONS, *Secretary, American Chemical Society.*

PLAN FOR THE IMPRESSMENT OF CHEMISTS FOR WAR SERVICE AS CHEMISTS AND FOR THE PRESERVATION OF THE SUPPLY OF CHEMISTS

I. There shall be organized a committee of three to advise the President of the United States through the War Department on requests for exemption of chemists. This committee might well include besides a government representative two chemists, one a chemical engineer or technical chemist, the second a university man. These men should be nominated to the President by the Council of National Defense.

II. Requests for exemption of individual chemists shall be made to this committee by:

1. Government, state or municipal laboratories and bureaus.

2. Heads of manufacturing plants on the basis of the imperative need of these men for their successful operation.

3. Presidents of universities, colleges and schools of engineering or mining on the basis of proficiency, promise and ability of candidates for college or university degrees, specializing in chemistry. Men recommended under this head who are candidates for the doctorate degree shall not be over 26 years of age when they receive the degree, and men who are candidates for a four-year college degree shall not be over 23 years of age when they are to receive the degree.

III. (1) Chemists under 21 and over 30 years of age and chemists between 21 and 30 who have not been drafted may enroll with the above committee as volunteers in chemistry subject to the same conditions as the enlisted and exempted men.

(2) Students in chemistry under 21 years of age may enroll with the above committee for a "chemists reserve" under the conditions specified in II. (3).

IV. Men thus enrolled and accepted under the provisions of the above paragraphs for war service as chemists shall be subject to the orders of the government as to location and nature of service and shall be entitled to wear a badge or other insignia indicating their official status (practise of France and possibly of other European countries). Students enrolled in a "chemists reserve" shall be subject to the same conditions as obtain for other reserves of the government and shall also be entitled to wear some insignia or badge indicating their enrollment.

SCIENTIFIC NOTES AND NEWS

A COMMISSION under the chairmanship of Dr. Frank Billings, of Chicago, is about to leave for Russia, under the auspices of the war council of the American National Red Cross. Its members include specialists in sanitary science, general medicine, tuberculosis, bacteriology and other branches of medicine, engineering, foods, transportation, business, etc. Mr. William B. Thompson, of New York, is assuming the expense of the commission.

FORTY-FIVE engineers of the topographic branch of the Geological Survey who are members of the Engineer Officers' Reserve Corps, have been assigned to active duty in connection with the military mapping now being done for the War Department. Among the men affected are Majors Frank Sutton, William H. Herron, Robert B. Marshall, Glenn S. Smith, George T. Hawkins, Robert Muldrow, James H. Jennings, William H. Griffin, Robert H. Chapman, Joseph H. Wheat and Albert M. Walker; Captains Claude H. Birdseye, Emory I. Ireland, Clyde B. Kendall, Albert Pike, Herbert H. Hodgeson, Carl L. Sadler, J. G. Staack, William L. Miller, Eugene L. McNair, Asahel B. Searle, William O. Tufts, Bertram A. Jenkins, James W. Bagley and Calvin E. Giffin. The list also includes twenty first and second lieutenants.

MR. HENRY S. GRAVES, chief of the U. S. Forest Service, has arrived in Paris to make arrangements for the forest work which the American army engineers will undertake in France in connection with the military operations of the allied forces.

DR. ALLERTON S. CUSHMAN, president of the Institute of Industrial Research, with headquarters at Washington, D. C., has been commissioned a major in the Officers' Reserve Corps, and will carry on special research work under the ordnance section on the chemistry of high explosives.

DR. ALEXIS CARREL, of the Rockefeller Institute for Medical Research, who has been at the

head of one of the French military hospitals, arrived in the United States on July 4.

Mr. C. P. Winslow has been appointed director of the Forest Products Laboratory to succeed Mr. H. F. Weiss, now in charge of the Division of Forest Products of the C. F. Burgess Laboratories. Dr. S. F. Acree severed his connection as chief chemist at the laboratory and is now with the National Wood Chemical Association, with headquarters at Syracuse University.

Dr. Frank D. Adams, of the faculty of applied science of McGill University, has been elected a foreign honorary member of the American Academy of Arts and Sciences, Boston, Mass., and also an honorary member of the Mineralogical Society of Russia at Petrograd.

Mr. J. J. Manley, the curator of the Daubeny Laboratory, has been elected to a fellowship at Magdalen College, Oxford, for the prosecution of special researches in physics and chemistry.

The committee on science and the arts of the Franklin Institute has awarded its Edward Longstreth medals of merit to Professor A. E. Kennelly, Messrs. F. H. Achard and A. S. Dana, for their joint paper entitled "Experimental researches on the skin effect in steel rails," appearing in the August, 1916, issue of the *Journal* of the Franklin Institute.

Mr. John Hall Sage, secretary of the American Ornithologists' Union was, on April 20, the guest of Dr. A. K. Fisher, at the camp of the Washington Biologists' Field Club, at Plummer's Island in the Potomac near Washington, D. C., where they were joined by sixteen other fellows and members of the union who gathered there in honor of Mr. Sage's seventieth birthday.

A complimentary dinner was recently given to Mr. Thomas J. Parker by some of his friends, at the Chemists' Club, New York City. The speakers were Dr. Milton C. Whitaker, Professor Chas. F. Chandler, Dr. Charles H. Herty and Dr. Hugo Schweitzer.

Dr. Robert H. Lowie, associate curator of anthropology at the American Museum of Natural History, has received a temporary appointment as associate professor in the University of California for the academic year 1917–18. He has been given a leave of absence by the American Museum of Natural History. In exchange, Professor A. L. Kroeber will join the staff of the museum during the first half of the year 1918.

Professor H. H. Bartlett has received leave of absence from the University of Michigan for the next year and a half in order that he may take charge of the laboratories of the United States Rubber Co. in Sumatra. At a recent meeting of the board of regents of the university, a letter was presented from Professor Bartlett with respect to a clause in the contract between himself and the United States Rubber Company relating to certain fellowships to be established in the university during Professor Bartlett's absence by the company in order to retain certain of Professor Bartlett's graduate students. This clause received the approval of the board.

Professor R. G. Hoskins, of the Northwestern University Medical School, has been appointed editor of *Endrocrinology,* the bulletin of the Association for the Study of the Internal Secretions.

Mr. George H. Ashley has returned to the U. S. Geological Survey, Washington, D. C., having concluded his term as acting professor of geology in Vanderbilt University. He took the chair of geology for six months in the absence of Professor L. C. Glenn.

W. E. Tottingham, assistant professor of agricultural chemistry, College of Agriculture, Madison, Wis., is on leave of absence and is working at Johns Hopkins University with Professor Livingston, on special problems in plant chemistry and physiology.

Julius Otto Schlotterbeck, professor of pharmacognosy and botany and dean of the College of Pharmacy of the University of Michigan, died on June 1.

The death occurred at Cambridge on June 9 of T. McKenny Hughes, F.R.S., Woodwardian professor of geology in the university, at the age of eighty-five years. He was elected

a fellow of the Royal Society in 1889, and received the Lyell medal of the Geological Society in 1891, when he acknowledged the value of his intimate association with Sir Charles Lyell, with whom he made many geological tours during his early years. As Sedgwick was elected Woodwardian professor in 1818 he and his successor have between them occupied the chair for ninety-nine years.

HORAS T. KENNEDY, geologist of the Geological Survey of Ireland, was killed on June 6 while serving as lieutenant in the British Army.

THE annual meeting of the American Chemical Society will be held in Boston on September 11, 12 and 13. We learn from the *Journal of Industrial and Engineering Chemistry* that the Northeastern Section has been requested by the directors to omit the usual annual banquet and excursions, and to arrange a program characterized by simplicity and seriousness, and bearing as fully as possible on questions concerning the activities of chemists both in the government service and in the industries during the present war. The general meeting will be held on Tuesday morning. This will be followed in the afternoon by a general conference to be opened by Dr. W. H. Nichols, chairman of the committee on chemicals of the National Defense Council, and by Dr. M. T. Bogert, chairman of the Chemistry Committee of the National Research Council, the conference then to be continued from the floor. It is expected that an informal, get-together meeting of a social character will be held on Tuesday evening, at which time opportunity will be given for informal discussion of problems of the day. Wednesday morning will be devoted to divisional conferences, and the afternoon to divisional meetings, with papers, or a continuation of the conferences, as the divisions may decide. The presidential address will be delivered on Wednesday evening. Thursday, both morning and afternoon, will be given to divisional meetings.

THE Rockefeller Foundation has awarded contracts for the building of two hospitals to cost $3,000,000. One of these will be located in Pekin and the other in Shanghai, and both will be for the work of the China Medical Board. It is also announced that the Foundation will send a hospital ship to the Moros and allied tribes of the Sulu Archipelago. The Philippine government is cooperating in this enterprise. The ship will cruise for five years among the many islands in the southern Philippine group. The foundation has learned that many of the Moros are suffering from skin diseases, malaria, hookworm, dysentery and other diseases.

THE state health commissioner of Massachusetts has appointed as a committee on the conservation of child life, Drs. David L. Edsall and William J. Gallivan, members of the public health council, and Dr. Lyman A. Jones, director of the division of hygiene of the state health department. As consulting members he has named Drs. Fritz B. Talbot, pediatrist and chief of the children's medical department, Massachusetts General Hospital; Richard M. Smith, Boston, pediatrist, assistant in pediatrics, Harvard Medical School; Walter E. Fernald, psychiatrist, superintendent of the Massachusetts School for the Feebleminded, and William Healy, psychologist, director of the psychopathic institute of the Chicago Juvenile Court, and Miss Mary Beard, director of the Instructive District Nursing Association.

THE *Journal* of the American Medical Association states that on June 20, a session was held at the College of Physicians and Surgeons, Philadelphia, at which physicians past the age for medical service organized for the reclamation of men physically unfit for the United States Army or Navy. Dr. W. W. Keen was elected president of the organization and as vice-presidents, Drs. John B. Deaver and James M. Anders. Physicians more than 55 years of age, doctors who can not pass the reserve corps medical examination and physicians who for other reasons can not go to the front, will form the membership of the organization which will include also dental surgeons, pharmacists and chiropodists. The plan is to have a camp where

men who have been refused service in the army or navy for minor defects may have these defects cured or so remedied that they will be able to enlist later. This is carrying out the plan of Dr. William Duffield Robinson, which won the approval of the surgeon-general. The entire equipment of the Germantown Hospital has been offered.

UNIVERSITY AND EDUCATIONAL NEWS

The will of the late Colonel Oliver H. Payne provides bequests of more than $7,000,000 to charitable and educational institutions. The largest gifts are to Yale University, Lakeside Hospital, Cleveland, and the New York Public Library, each of which will receive $1,000,000. An endowment of $500,000 is bequeathed to the Cornell University Medical College. Other gifts include: Phillips Academy, Andover, Mass., $500,000; St. Vincent's Charity Hospital, Cleveland, $200,000; Cleveland Jewish Orphans Asylum, $200,000; Hamilton College, Clinton, N. Y., $200,000, and the University of Virginia, $200,000.

Mrs. Reed, widow of late Dean John O. Reed, has presented to the library of the department of physics of the University of Michigan about 400 scientific books and bound reprints from the library of Professor Reed, the books being principally on physics and mathematics. There was received from Mrs. Reed, also, a gift of eight prisms of special design of various kinds of glass and natural crystals made by Professor Reed and used by him in research work. Mrs. Guthe, widow of the late Dean Karl E. Guthe, has presented to the library about 100 volumes of scientific works from Professor Guthe's library, together with about 1,000 catalogued reprints of scientific papers and a card catalogue of several thousand references.

Professor Robert DeC. Ward, of Harvard University, is giving instruction in meteorology in the school for the preliminary training of aviators, recently established at the Massachusetts Institute of Technology, in cooperation with the War Department. For the purposes of this work, Professor Ward has become a member of the teaching staff at the Institute of Technology, and, under orders from the War Department, has been to Toronto to familiarize himself with the instruction which is there being given at the Cadet School of the Royal Flying Corps.

The State College of Forestry at Syracuse announces the appointment of Mr. Ernest G. Dudley, of Leland Stanford University and the Yale Forest School, as assistant professor of forest extension. Mr. Dudley goes to the college from the U. S. Forest Service in California where he has recently been in charge of the Forest Service Exhibit at the Panama-California Exposition in San Diego.

Dr. Milton C. Winternitz, formerly associate professor of pathology in Johns Hopkins University, has been elected professor of pathology in the school of medicine of Yale University.

DISCUSSION AND CORRESPONDENCE

A REMARKABLE COINCIDENCE

The most remarkable coincidence known to me relates to the discovery of Perrine's second comet. I published the facts in the case in *The Observatory,* Vol. 26, pp. 293–94, 1903, where they were made familiar to many astronomers. On describing the coincidence recently to a group of my colleagues in other sciences they urged strongly that I republish the facts in a journal of more general character, and thus make known the occurrence to students in other subjects.

Professor Charles D. Perrine, of the Lick Observatory staff, discovered the first of his many comets on November 17, 1895. This was Comet *c* 1895. He observed it night after night until December 20, 1895, when it was lost to sight in the glare of the sun's rays. The orbit of the comet was accurately determined, and its path for the early months of 1896 was computed and published in advance. I had the pleasure of assisting Mr. Perrine when he first looked for its reappearance from behind the sun, on the morning (just before dawn) of January 30, 1896. He found it at once, in the

predicted position, and as an object easily visible in medium-sized telescopes. Because the comet was following its predicted path so closely we decided not to squander money in cabling the fact of its reobservation to European observers. Perrine observed his comet morning after morning as weather permitted, for fifteen days, until on February 14 a cablegram was received from Kiel, Germany, announcing that Lamp had reobserved Perrine's Comet *c* 1895 that morning. The cablegram in cipher code was received at the Lick Observatory by one of the astronomers, in perfect order as shown by the control word; but in converting the cabled right ascension of the comet from degrees and minutes of arc into hours and minutes of time the translator made an error of 24 minutes of time, equivalent to 6° of arc. The *erroneous* translation was handed to Perrine. He compared this with what he knew to be the real position of Comet *c* 1895, by virtue of his observations in the preceding half month, and saw that there was a discrepancy of about 24 minutes of time. Inasmuch as the check word in the cablegram was correct he judged that the object observed by Lamp in Kiel must be a different comet from his own. The following morning was clear and he pointed the 12-inch telescope to the position that was handed to him. In looking through the finder of the telescope *he saw an eighth magnitude comet in the field of view.* This did not surprise him. He observed the position of the new comet, and we transmitted the observation by telegraph and cable, as usual, as belonging to a new comet discovered by Lamp in Kiel. This new object was at once known as Comet *a* 1896. Naturally considerable mystery existed (see *Astronomical Journal,* Vol. 16, p. 56, 1896, and *Astronomische Nachrichten,* Vol. 139, pp. 365–66, 1896). Several weeks elapsed before the tangled situation was unravelled at Mount Hamilton by our looking up the original cipher cablegram and detecting the error of 24 minutes in the conversion of arc into time, made after the cipher message had been translated and checked.

It is a surprising fact that the error should have directed the telescope upon an unknown comet, but the surprise increases when we consider another attendant fact. The new comet was moving amongst the stars very rapidly; more than 2° east in right ascension and more than 3° north in declination, daily. When the cablegram was written in Kiel on the morning of the fourteenth the new comet was six or seven degrees from the cabled position. When the erroneous position was handed to Perrine on the morning of the fourteenth the new comet was three degrees from that position. When the first opportunity came, the following morning, to examine the erroneous position, the rapidly-traveling comet had moved into that position. Had the telescope been pointed to that position on any other morning whatsoever, the celestial visitor would have been far outside the finder field, and the chances are fair that it would have come and gone unseen. The cabled Kiel position of reobservation of Comet *c* 1895 and Perrine's position of Comet *a* 1896 were:

Comet *c* 1895, Feb. 14, R. A. = 19 h. 45 m.,
Dec. = — 2° 23′ (correct translation).
Comet *c* 1895, Feb. 14, R. A. = 19 h. 21 m.,
Dec. = — 2° 23′ (erroneous translation).
Comet *a* 1896, Feb. 15, R. A. = 19 h. 22 m.,
Dec. = — 2° 49′.

The angular radius of the finder field was about 1° .3.

I doubt whether another case of coincidence as remarkable as this one is on record in the literature of astronomy.

W. W. CAMPBELL

LICK OBSERVATORY,
June 4, 1917

REPORT OF DR. E. H. WILLIAMS ON THE FIRST PHASE OF PENNSYLVANIA GLACIATION

WHEN in 1880 Professor Lewis and myself conducted the survey of the terminal moraine across Pennsylvania (the results of which are embodied in volume Z of the Second Geological Survey of the State) we supposed at the outset that we were following the actual limit of glaciation. Soon, however, we were convinced of our error and spoke of a "fringe" of territory sparsely covered with glacial markings, extending an indefinite distance

beyond. In deference to others we had no objection to substituting the words "attenuated border" for the word we had selected. The only person who has studied this "attenuated border" comprehensibly and in detail, in Pennsylvania, is Dr. E. H. Williams, Jr., whose attention was called to the problem twenty-five years ago, while he was lecturer on mining and geology, at Bethlehem.

By good fortune Bethlehem is almost exactly on the exterior limit of this attenuated border; and Dr. Williams' familiarity with the mineralogy of the region and with the many problems connected with the work of mining engineering, specially fitted him for prosecuting the investigations which he began and pursued at his own expense until the work was completed. Though many of the results of this work had been presented in piecemeal in various publications, it is only now that they are published in complete form and with adequate description and illustrations, of which there are no less than fifty-six, mostly photographic reproductions.

Following the example of Professor Chamberlin, who first gave a satisfactory explanation of the lobate character of the moraines west of Pennsylvania, in the topography of the region, Dr. Williams has brought to light as never before the causes operating to direct and limit the movements of the ice over the mountainous regions of New England and the Middle States.

1. There was a lobe extending southward between the Green Mountains and the Adirondacks through the Hudson Valley, the rock floor of which, between Lake Champlain and the Hudson River, was only 150 feet above tide. The average breadth of the upper Hudson Valley between the 500-foot contour is sixteen miles. Between the 1,000-foot contours it is thirty-two miles; but at South Kingston, New York, Storm-King and Marlborough Mountains rise abruptly 1,200 feet above the valley with a gorge between them, through which the river flows, only three fifths of a mile broad at the 500-foot contour and two miles at 1,000 feet. As a consequence the ice stream was diverted to the southwest through the Walkill-Rondout saddle into the great Pennsylvania valley, extending as far as Bethlehem, and damming up the Lehigh Valley so that the outflow of the drainage was turned over the watershed between the Lehigh and the Schuylkill at Topton; thus accounting for the glacial drift, which had been recognized by Salisbury, in the Schuylkill River at Norristown.

A natural explanation of the northwest trend of the glacial border, as shown in eastern and middle Pennsylvania, is found in the gradual rise of land to the west, which in Potter County attains an elevation of 2,500 feet. But in Schuylkill County the swelling mass of ice surrounding and finally overtopping the Catskill Mountains penetrated to Morea a few miles north of Pottsville leaving glacial markings of great interest on the surface of the mammoth coal bed, at an elevation of 2,100 feet above tide.

Again, as the Labrador ice advanced and increased in volume, passing around the elevation of the Adirondack Mountains it penetrated the Mohawk Valley through the Black River sag and entered the east fork of the Susquehanna, reaching the valley of the West branch at Williamsport and crossing over it so as to produce a dam causing the water to extend up Eagle Valley and run over into the Juniata at Tyrone, thus accounting for the glacial débris that I. C. White had found in the lower Juniata.

But it is in northwestern Pennsylvania that most interesting facts come to light. It appears that there was a long interval after the Kewatin and the Labrador glaciers set out upon their careers before they became confluent; so that when the Kewatin ice invaded the valley of the Great Lakes and poured its torrential drainage into that valley, Labrador ice was obstructing the eastward exits both through the St. Lawrence and through the Mohawk. This caused a rise of water over the basin of western Ontario and western New York, until, through the Conewango, it eventually found an exit into the Allegheny Valley, which then was not continuous but was separated by a col somewhat

south of Franklin from which streams were flowing both north and south. But this col was rapidly reduced by the glacial torrents and thus the present channel was formed. It was during this period that those remarkable deposits in the Conewango and the Allegheny about Warren were formed. At the bottom there is an immense deposit of fine sediment in horizontal laminæ giving place towards the surface, which rises 300 feet or more from the rock bottom, to coarser deposits indicating a southward flow of water.

One of the most interesting discoveries at this point is a nugget of Lake Superior Copper embedded in undisturbed deposits of glacial origin, dropped as Dr. Williams believes by icebergs floating in this temporary lake. Nuggets of copper which Dr. Williams is pretty confident are from the Lake Superior region are also found in glacial deposits of eastern Pennsylvania, brought thither as he believes by icebergs, which in an earlier period passed through the Mohawk Valley before it was completely obstructed by the Champlain-Hudson lobe of ice.

Dr. Williams names his brochure "Pennsylvania Glaciation; First Phase," and gives ample reasons for believing that in the East, at any rate, there is not that immense separation between the earliest and latest phases which geologists in the Mississippi Valley have been accustomed to assume as separating the Kansan from the Wisconsin stages. In Pennsylvania it is certain that such a wide separation can not be maintained; for, though it is true that the glacial deposits over the attenuated border are in general more highly oxidized than those in and north of the moraine, *they are not all highly oxidized.* Mingled with the highly oxidized material of this area there is a small proportion of comparatively fresh material, and it is that which must determine the age. It is evident that the most of the material on the attenuated border was oxidized in preglacial times and was brought forward in that condition by the ice movement. For example, numerous pebbles are found which are oxidized on the outside, while there is a core on the inside that is unoxidized, while in some instances such pebbles have been ground off on one side by the glacial movement, exposing this unoxidized core and leaving the thick covering of oxidization on the other side.

Certainly the scientific public is greatly indebted to Dr. Williams for the pains which he has taken: first, to collect the facts which are found in this brochure, and second for bringing them before the public in such full measure, at his own expense. No glacialist can afford to remain ignorant of the facts and discussion of principles contained in it. The reader will lack only a detailed map of the state of Pennsylvania, which he needs to have constantly before him. The small relief map accompanying the publication is good so far as it goes, but needs to be supplemented for reference by one that gives minute details of topography and geology.

G. FREDERICK WRIGHT

OBERLIN,
May 22, 1917

QUOTATIONS

THE WAR AND SCIENTIFIC INVESTIGATION

THE commendable patriotic ambition of every rightminded American to render his best help in the time of his country's need has raised questions of choice for many citizens. The spirit of service is rife throughout the country, and one's first impulse frequently urges him to enter those avenues of activity that lead nearest to the combat. A sane, calm review of the situation indicates, however, that there are many fields which require profound attention, even though they often seem quite remote from the trenches. The chemist in the munitions works, the bacteriologist who is testing the efficiency of the latest antiseptics, the agriculturist who is striving to solve the immediate difficulties of farm practise or aiding in the "speeding up" of the production of staple crops, live stock and other food products—all of these workers are an indispensable part of the great human organization that must cooperate to lead the way to victory. Frequently many workers, par-

ticularly younger men engaged in important investigations, gain the uncomfortable feeling that they are not doing their full duty when they plod along so far removed from the noise of the conflict. Such persons need encouragement at the present moment. They must not all be permitted to withdraw from the less conspicuous though highly important labor of productive investigation which may anticipate the needs of the hour. The war has already directed attention as never before to the intimate relations between science and industry, as well as to the vital necessity of fostering these relationships. Two generations ago, Dr. Lyon Playfair deplored the holding "to mere experience as the sheet anchor of the country, forgetful that the molds in which it was cast are of antique shape, and ignorant that new currents have swept away the sand which formerly held it fast, so that we are in imminent risk of being drifted ashore." Despite the brief period full of the enormous difficulties of organizing a great military campaign and instituting active defenses as well as naval warfare, substantial headway has already been made in the mobilization of scientific investigation. Researches can not be manufactured on command or completed over night. Nevertheless the National Research Council has already made a commendable beginning in a movement that will enlist some of the best scientific minds of the nation and encourage them to continue the work for which they are specially trained and best equipped. In our enthusiasm for the more apparent helps to success we must not forget these potent silent forces, nor allow the leaders of the nation to overlook the need of supporting and stimulating them. Even war thrives thrugh the fundamental discoveries of science. —The *Journal* of the American Medical Association.

SCIENTIFIC BOOKS

Tomorrow: Letters to a Friend in Germany. By Hugo Münsterberg. D. Appleton & Co. $1.

As soon as Columbia really sets her face toward peace, the war clouds will be dispelled and the age of our hopes will dawn. My mind is gleaming with radiant hopes. Peace must come soon, and who knows, my friend, when the roses bloom again in your beautiful garden, one of the German ships interned here in Boston may have brought me back to the Fatherland to you. I am sure in one wondrous hour at home I can tell you face to face so much more than I have told you in these letters. Yes, when the roses bloom. . . .

The roses will bloom, and perchance peace will come, but the author of these hopeful words has departed, leaving a message which will not soon be forgotten. Professor Münsterberg wrote his last book, well called "Tomorrow," in the form of letters to a friend in Germany. The professor of psychology has given us a study of extraordinary psychological interest; wherein, under a certain appearance of unity, we see the ferment of German and American ideals, and their influence on a scholarly mind. When he came to this country, Münsterberg stipulated that he would remain a German citizen. He did so remain, in a political sense; yet he could not escape Americanization, and his last wish, in the midst of war and of anti-Germanism, is for the union of Germany, England and the United States!

Nevertheless, the German point of view is never forgotten. The ideal is nationalism, combined with a not too insistent internationalism. Science, philosophy, art, must be international; the new nationalism of Germany, which "pleads for a kind of intellectual embargo," is petty and dangerous to real culture; yet "truth must be clothed in its national garb." What is nationalism? It is not the cult of race: "we have heard so often and with so much assurance the story of the omnipotence of race in human history. The true psychologist always knew that it was a legend, and the war has demonstrated it again." Yet, we are told, "in every nation we grasp a oneness of traditions and memories, of language and customs, of laws and literature, of arts and sciences, of commerce and politics, of morals and religion." Do we, indeed? In Switzerland or the British Empire, for example? Is

it not a fact that the nation, as nations go today, is an artificial alliance for economic purposes? The real groupings of mankind, in a spiritual, intellectual or even historical sense, are usually not coincident with national boundaries, and afford no support to the doctrine that nations are the most sacred of all human units. How far Münsterberg could be led astray by the ideal of nationalism is shown in his defense of the militant professors who, "uplifted by a healthy patriotism," proclaimed historic and political facts as they appeared from the angle of their hopes (p. 37); yet he hastened to add that "while our beliefs may clash, no hatred ought to darken our vision."

The new idealism, as interpreted by Münsterberg, is that of organization for public service. "Where individualism prevails, subordination is unwelcome; and that means that dilettantism flourishes and the expert is powerless. The dilettant is now ruled out and the triumph of the expert secured all over the world for the days to come; organization replaces haphazard performance; the self-conscious will of the group suppresses the individual whim. To have attained this is the most important victory of the German nation. If the war brought nothing else, this alone may make us feel that those who died on both sides did not give their lives in vain" (p. 137). With this interpretation, the new nationalism finds fresh meanings. The nation is now the cooperative unit. It is the machine, all parts of which work together in harmony. Why not extend this idea further, and let the unit be mankind?

The conception of universal cooperation, once we have grasped and appreciated the extraordinary coherence of such a strange conglomeration as the British Empire, is simple and attractive. Since nations, artificial as they are, are such workable units in time of stress, what is to prevent the extension of the national method until nations are no more? Münsterberg looked forward to something like that: "the world federation ought to be an ideal . . . but it must have ages to mature." It can not come through law, but must arise "out of the needs of the active nations," must be dynamic and constructive.

The interplay of diverse ideas and ideals produces inconsistencies which alternately irritate and charm. It is irritating to find what seems to be a failure in the integrity of scientific reasoning, but one is charmed at the naïve sincerity of the utterances. After all, the road to salvation is not the straight and narrow path we have been led to imagine, but has many turns. Every promising path appears to have its obstacles and its dangers. Even the federation of the world might lead to an ossification of the springs of originality in mankind. State socialism may go the way of all organization carried to extremes, and lead to petrefaction.

History shows us that the causes of progress are largely individual. The new movement arises as a consequence of the breaking away of some personality from the fetters of the established order. He may be crucified, but his work permeates society, and fructifies through social cooperation. Thus individualistic and socialistic forces are alike indispensable for progress. Münsterberg seems not to have fully appreciated this; the Germans, as a nation, do not appreciate it, and that is why we dread the "Prussianization" of the world. On the other hand, we have not sufficiently appreciated the importance of organization; and here in America, in particular, the work of individuals fails for lack of adequate cooperation.

We grant with Münsterberg that a genuine idealism is at the base even of German warfare. He himself defines it exactly. "It is a belief in 'absolute' values. . . . Belief in absolute values means simply that the deed is valued independent from the pleasure it brings. . . . If we are filled with the belief that an action has value without any reference to pleasure or pain, then we credit it with absolute value. To be guided in life by such a belief is idealism." This conception is expanded quite fully, and as presented has its attractive side. Indeed, who can go through life sanely or usefully without some such idealism, some belief in unprovable axioms or "absolute values"? Yet modern science becomes more and more experimental, more and more inclined to test all things, and hold fast to that which is good,

as shown by the test. Pragmatism may be vicious when narrowly conceived, but the pragmatic attitude leads us away from dogmatic idealism toward intelligent action. The German army, in its conduct toward its own members as well as its treatment of the unfortunate peoples who come under its power, does indeed strive for "values" independently of pleasure or pain. Nationalistic idealism can be made the excuse for deeds which could find no justification in the presence of the simplest enquiries into consequences, as measured by those supposedly negligible phenomena, human pleasure and pain. Münsterberg, great-hearted and striving after good, would not have so far forgotten the relations between cause and effect; but we must combat any philosophy, any course of action, which does not incessantly seek justification by results measured in human welfare.

T. D. A. Cockerell

SPECIAL ARTICLES

A RHYTHMICAL "HEAT PERIOD" IN THE GUINEA-PIG

During the past six years we have been using guinea-pigs in an extensive breeding experiment and it has become more and more evident as our work goes on that the existing notions of the ovulation periods in these animals are of no practical value, or are practically incorrect. In a number of the experiments it became important to know accurately when the females "came into heat" and when ovulation took place. We had concluded, from numerous observations as well as theoretically, that the female guinea-pig very probably had a definitely regular and periodic sexual cycle if it could be worked out exactly. On account of the need of this exact information, we have studied the œstrous cycle in these animals during the past eighteen months.

Most other attempts at a solution of this problem have centered in a study of the ovary, which necessitated either its removal by operation or the killing of the animal. In either case the procedure brought to a conclusion the observation or experiments on the ovulation cycles in that specimen. Recognizing, on the other hand, that no thorough investigation of the uterus and vagina in the living female had been made, it occurred to us that possibly œstrous changes might take place even though they are so feebly expressed as not to be noticeable on casual observation. The absence of an apparent œstrous or proœstrous flow from the vagina of the guinea-pig has, no doubt, been the chief reason for the general lack of knowledge of the œstrous cycle. It was, therefore, determined to make a minute examination of the contents of the vaginæ of a number of females every day for a long period of time to ascertain whether a feeble flow might exist, although insufficient in quantity to be noticed at the vaginal orifice or vulva.

The observations were made by using a small nasal speculum which was introduced into the vagina and the arms opened apart by means of the thumb screw. This instrument permits an examination of the entire surface of the vaginal canal. In this way the vaginæ of a number of virgin females have been examined daily and smears made from the substances that happened to be present in the lumen.

By the use of such a simple method, it was readily determined after examining the first lot of animals for a few months that a definite sexual period occurs lasting for about twenty-four hours and returning with a striking regularity every fifteen or sixteen days. During this twenty-four hour period the vagina contains an abundant fluid which is for about the first half of the time of a mucous consistency. The vaginal fluid then changes into a thick and cheese-like substance which finally becomes slowly liquefied and serous. This thin fluid exists for a few hours and then disappears. Occasionally toward the end of the process a slight trace of blood may be present, giving the fluid a bloody red appearance, otherwise it is milk-white or cream color.

According to the changes in appearance and consistency of the vaginal fluid, one may distinguish four different stages. The first stage having a mucous secretion, a second stage the cheese-like secretion, a third stage with the fluid becoming serous and a fourth stage, not always recognized, during which a bloody dis-

charge is present. The duration of these several stages is subject in the different animals to individual variations. The first stage, however, is generally longest and lasts from six to twelve hours or even more, and during this time there is a gradually increasing quantity of the mucous secretion which at its height is very abundant and fills the entire lumen of the vagina. The second stage is shorter, lasting from two to four hours, and passes gradually over into the third stage which lasts from four to six hours. The fourth stage is the shortest, only about one to two hours long, and for this reason it is often missed in examining the animals during the periods. It is also possible, as mentioned above, that the fourth stage may not typically exist in all individuals and the quantity of blood present is very different in the different specimens. The succession in which these stages follow one another is remarkably definite. We have never observed any change in the typical sequence of the stages and the time consumed by the entire process is closely the same in all cases.

A macroscopical examination of the uterus and vagina during this period of sexual activity shows the entire genital tract to be congested. The vessels to the ovary, uterus and vagina are large and conspicuous, the uterine horns and the vagina are slightly swollen and inflamed. However, as soon as this short period of activity is over, the congestion disappears and the uterus and vagina take again their normal pale aspect. At the same time the vaginal fluid diminishes and the vagina, especially during the first week after the sexual activity, is as clean as possible, showing none of the secretion. The external vaginal orifice, which during the period of activity is more or less open, actually showing in a few cases a little fluid or some blood, closes and becomes less accessible after the period.

During the second week following œstrus a little mucous discharge begins to appear in the vagina and increases progressively, indicating that the new period of activity is nearer and nearer approaching. The orifice of the vagina is sometimes open during this stage and thus explains why this sign, which was observed before, does not make it possible to detect the actual time of the regular œstrous activity.

The complete results of the present study which will be published in full elsewhere may be stated in brief as follows.

Guinea-pigs kept in a state of domestication and under uniform environmental conditions possess a regular diœstrous cycle repeating itself in non-pregnant females about every sixteen days throughout the entire year with probably small and insignificant variations during the different seasons.

During each cycle typically corresponding changes are occurring in the vagina, the uterus, and the ovary; a given stage in one of these organs closely accompanying parallel stages in the other two.

Each period of sexual activity lasts about twenty-four hours and is characterized by the presence of a definite vaginal fluid, which is not sufficiently abundant to be readily detected on the vulva, but is easily observed by an examination of the interior of the vagina.

The composition of the vaginal fluid changes with the several stages of change occurring in the uterus and vagina.

(*a*) To begin with, during what we term the *first stage,* the fluid consists of an abundant mucous secretion containing great numbers of desquamated vaginal epithelial cells. At this time sections of the vagina show an active shedding or desquamation of its epithelial lining cells. The cells of the uterine epithelium are loaded with mucus, and an active migration of polynuclear leucocytes is taking place from the vessels of the vagina and uterus out into the stroma and towards the epithelial layer.

(*b*) During the *second stage* the contents of the vagina become thick and cheese-like on account of the great accumulation of desquamated epithelial cells. The walls of the uterus and vagina become congested and the migration of leucocytes becomes still more active.

(*c*) The leucocytes reach the epithelium and vigorously invade its cells and intercellular spaces during the *third stage.* These wandering cells become enclosed within and apparently dissolve the breaking-down dead cells of the epithelium. The vaginal fluid becomes

thinner under the dissolving or digesting action of the leucocytes. The congestion in the uterus and vagina becomes still more pronounced, giving rise to small blood masses or hæmatomata beneath the epithelium. The epithelium of the uterus is highly disorganized, vacuolized and richly invaded by the leucocytes, so that portions of it fall away en masse, actually carrying with it in some cases cells of the stroma.

(*d*) The *fourth stage* is merely a continuation or result of the activities of the third. The falling away of the epithelial pieces and stroma cells permits the escape of the small hæmatomata or blood knots, thus causing a slight bleeding into the lumen of the uterus and vagina. These traces of blood often give a reddish aspect to the vaginal fluid. At this same stage a regeneration process begins from the necks of the uterine glands and also apparently from the epithelial infoldings in the vagina, so that the lost epithelium becomes rapidly replaced almost before it has ceased falling away.

The regeneration process in the guinea-pig is very short, lasting only a few hours, from six to twelve in all.

Ovulation seems to occur spontaneously during every heat period without exception. The rupture of the follicles with the consequent ovulation takes place about the end of the second stage or the beginning of the third; that is, during the presence of the thick cheese-like vaginal fluid.

During the dicestrum or intermenstrual period there is very little fluid to be found in the vagina. This scant fluid consists of mucus in which are some atypical squamous cells from the vaginal wall and many leucocytes. A number of the leucocytes are old but there are probably new ones arriving almost continuously from the wall of the vagina. The only time at which the vagina seems to be practically free of leucocytes is immediately before and during the first and second stages of the œstrous period described above.

A marked correlation exists between the œstrous changes in the uterus and the developmental cycle of the corpora lutea. When the corpora lutea are highly developed and apparently active the mucosæ of the uterus and vagina show a normally vigorous and healthy condition. While on the other hand, when the corpora lutea begin to degenerate during the second week after the "heat period" the mucosæ of the uterus and vagina also begin to shown signs of degeneration and the process of desquamation slowly commences. At about two weeks after the last "heat period," when the wholesale destruction of the mucosa begins, the corpora lutea are almost completely degenerated. The breaking of the Graafian follicles occurs during the œstrus as a result of a congestion which began in the theca folliculi at about the same time as the congestion of the stroma of the uterus and vagina. And finally when the regenerative growth of the uterine mucosa sets in, the ovaries then possess new corpora lutea in an active state of differentiation which were derived from the recently ruptured follicles.

It, therefore, might be imagined that the secretion from the corpora lutea exerts a protective influence over the uterus and vagina while the absence of this secretion permits the breaking down and degeneration of the uterine epithelium typical of the "heat period."

C. R. Stockard,
G. N. Papanicolaou

THE IOWA ACADEMY OF SCIENCE

The thirty-first annual session of the Iowa Academy of Science was held at Grinnell College, Grinnell, on April 27 and 28. The opening meeting was called to order on Friday afternoon by President Stewart, of the State University. After the transaction of preliminary business the president delivered his annual address on "Recent advances in physical science and the relation of the Iowa Academy to scientific progress." Professor Conard, of Grinnell, who had been the academy's delegate to the tenth annual meeting of the Illinois Academy of Science, gave a report of that meeting. A number of papers of general interest were read and the president announced that other papers would be read before the appropriate sections, which were: 1, Geology; 2, Zoology and Botany; 3, Mathematics, Physics and Chemistry.

Professor R. A. Millikan, of the University of Chicago, was to have given the annual address, but

as he was unable to leave his work on the Council for National Defense, at Washington, Professor S. M. Woodward, of the University of Iowa, gave the address on the "Application of science to flood prevention," an outline of his work on the Dayton, Ohio, flood-prevention project.

Following the meetings of the sections on Saturday morning the business meeting was held, at which the following officers were elected for the coming year.

President—L. S. Ross, Drake University, Des Moines.

First Vice-president—S. W. Beyer, State College, Ames.

Second Vice-president—C. E. Seashore, State University, Iowa City.

Secretary—James H. Lees, Iowa Geological Survey, Des Moines.

Treasurer—A. O. Thomas, State University, Iowa City.

Resolutions were adopted pledging the support of the academy to the President of the United States, also commending the action of the Iowa legislature in passing laws to give quail and prairie chicken a closed season of five years and providing for a board of conservation to investigate localities in Iowa which are of scenic, scientific and historic interest.

PROGRAM

Geology and Allied Subjects

A notable mound group near the proposed government park at McGregor: ELLISON ORR.

(*a*) *Wave action and results of ice action as seen near the Macbride Lakeside laboratory, summer of 1916.* (*b*) *Second record of oscillations in lake level, and records of lake temperatures and meteorology, at the Macbride Lakeside laboratory, July, 1916:* JOHN L. TILTON.

Possible fan structure in Canadian Rockies: CHARLES KEYES.

The Cordillera in Jasper Park, in northwest Alberta, as in other parts of the great mountain chain, is characterized by tremendous thrust planes; but unlike most other portions there is on the east flank a sharp flexing on a large scale. The especially notable feature is the Appalachian or Alpine type of structure. The relationships of the various members are presented with greater perspicuity than anywhere else throughout the entire extent of the Rocky Mountain region, perhaps with greater graphic distinctness than Appalachian structure is exhibited in the whole world. A hundred miles farther south, on the west side of the chain, the pre-Cambrian clastics with steep but variable slants indicate the presence of the other half of the orographic fan.

Glacier dams of central Washington: CHARLES KEYES.

Extent and age of Cap-au-Grès fault: CHARLES KEYES.

A bibliography of the driftless area: W. D. SHIPTON.

(*a*) *The Iowan glaciation and the so-called Iowan loess deposits.* (*b*) *Post-Kansan erosion.* (*c*) *The Buchanan gravels of Calvin and the Iowan outwash:* M. M. LEIGHTON.

The loess and the antiquity of man: B. SHIMEK.

History of the Pleistocene in Iowa: EMMET J. CABLE.

Pleistocene deposits between Manilla in Crawford county and Coon Rapids in Carroll county, Iowa: GEORGE F. KAY.

The most significant features that have been revealed by a study of the Pleistocene deposits in many deep cuts made recently between Manilla in Crawford county and Coon Rapids in Carroll county, by the Chicago, Milwaukee and St. Paul Railway Company, were described.

Ocheyedan mound, Osceola county, Iowa: GEORGE F. KAY.

This brief paper describes the chief characters of the long time famous Ocheyedan mound, which is thought by many persons to be the most picturesque topographic feature in northwestern Iowa.

The mound is a kame which was formed during the recession of the Wisconsin ice sheet.

The esthetic value of such beautiful and interesting geological phenomena as Ocheyedan mound should be fully appreciated by the citizens of the state, and every effort should be made to prevent their destruction. Already Ocheyedan mound has been somewhat marred by the removal at its summit of sand and gravel which was used for commercial purposes. To be sure, the mound is valuable for the many thousands of tons of material that might be taken from it to be used for road-making or other purposes, but of far greater value is it to the state as a beauty spot, a landmark, which should be conserved for future generations just as zealously as we are wont to conserve our material resources.

A note regarding a slight earthquake at Iowa City, on April 9, 1917: GEORGE F. KAY.

A supposed fruit or nut from the Tertiary of Alaska: A. O. THOMAS.

The specimen, which was collected in the coal-bearing beds of the Tokun formation, is about 8 cm. in diameter. The symmetrical arrangement of certain meridional and other lines on its surface and attached fragments of what appears to have been an epicarp suggest that it may be a fossil fruit or nut. Other possibilities are suggested.

A large colony of fossil coral: A. O. Thomas.

A coral colony of gigantic proportions was recently discovered in a reef of Niagaran corals in Jones county. Conditions under which the colony occurs, its dimensions and associations, are described. Illustrations.

Notes on a decapod Crustacean from the Kinderhook shale near Burlington: Otto Walter.

Mississippian crustaceans are comparatively rare. An incomplete specimen found imbedded in a hard shaly nodule is described. It seems to be allied to the old genus *Paleopaleomon.*

Some observations on the history of Yangtse River, China: C. L. Foster.

Some geologic aspects of conservation: James H. Lees.

Some of the beauty spots of Iowa are described and their scenic and geologic values are mentioned. The necessity for their preservation is emphasized.

Some fundamental concepts of earth history: James H. Lees.

After a brief discussion of the evidence for progressive development of the material world there is given an outline of the trend of thought regarding the history of the earth. This outline covers the work of leading thinkers from the Greek and Roman philosophers to the great systems evolved by La Place and Chamberlin.

(*a*) *The Prairie du Chien-St. Peter unconformity in Iowa.* (*b*) *The origin of the St. Peter sandstone.* (*c*) *Some conclusions concerning the erosional history of the driftless area:* A. C. Trowbridge.

Home Economics

Improved method for home canning: C. N. Kinney and Maurice Ricker.

Suggested use of calcium chloride and other salts in solution in outer vessels of double boilers to raise boiling point in inner vessel.

Experiments in cooking cereals, canning fruit and vegetables indicate that this cheaper device may replace the auto-clav for these purposes, especially when the inner vessel is subjected to slight pressure.

Physics

(*a*) *Certain features of rheostat design.* (*b*) *An interesting case of resonance in an alternating current circuit:* H. L. Dodge.

The absence of relationship between electro-mechanical properties of selenium crystals and their photo-electric emission by ultra-violet light: F. C. Brown and F. S. Yetter.

The X-ray K-radiation from tungsten: Elmer Dershem.

The influence of intensity ratio in binaural sound localization: E. M. Berry and C. C. Bunch.

A peculiar electrically conducting layer on the surface of mica: G. W. Stewart.

On the torsional elasticity of drawn tungsten wires: L. P. Sieg.

The thermal conductivity of tellurium: Arthur R. Fortsch.

(*a*) *Electrical capacity of similar, non-parallel plane plates, and its application where the plates are non-rectangular.* (*b*) *Mathematics of stroboscopy; The strobodeik; Theory of the stroboscopic effect by reflection of light from vibrating mirrors.* (*c*) *Precontact conduction currents:* L. E. Dodd.

Effect of drawing on the density and specific resistance of tungsten: Wm. Schriever.

Effect of gases on unilateral conductivity: Robert B. Dodson.

Zoology and Allied Subjects

Birds of the past winter, 1916–17, in northwestern Iowa: T. C. Stephens.

A list of the birds observed in Clay and O'Brien counties, Iowa: Ira N. Gabrielson.

An annotated list of the mammals of Sac county, Iowa: J. A. Spurrell.

Bell's vireo studies: Walter W. Bennett. (Illustrated with lantern.)

Observations on Bell's vireo, a species of the central United States which has heretofore been little studied. Near Sioux City it arrives unobtrusively from the south during the second and third weeks in May. During nesting, which immediately follows, the bird has been found to sing on the nest after the fashion of the warbling vireo. A tendency of the bird to become easily tamed, a habit of very frequently sitting for long periods in a resting attitude near the nest, and other characteristic actions have been noted. Also, an unusually large proportion of cowbird's eggs in their nests and other facts point to a possible diminishing number of individuals of the species, at least near Sioux City.

An analysis of the cranial ganglia in Squalus acanthias: SALLY P. HUGHES. (Illustrated with lantern.)

This analysis confirms the results of Strong (1903) and Landacre (1916). The trigeminus ganglion is constricted into a ventral maxillaris and a dorsal mandibular and superficial ophthalmic portion; the ophthalmicus profundus has a distinct ganglion. The facialis comprises the geniculate ganglion, a motor root distributed through the hyomandibular trunk, and three lateral line ganglia—a buccal, a superficial ophthalmic VII., and a third out in the hyomandibular trunk—the fibers from the last two forming the dorsal lateral line root, those from the buccal, the ventral. The auditory ganglion is distinct, rising by a large root just ventral and posterior to the lateral line roots of the VII. The IX. ganglion is visceral sensory with a small lateral line ganglion in its anterior end. The lateral line fibers rise by a small separate root just barely in contact dorsally with the lateral line root of the X. The vagus rises by a large anterior lateral line root followed by a succession of visceral sensory and motor roots. There are three lateral line ganglia on the X., almost fused together. A small general cutaneous element is given off with fibers from the first two of these. The visceral ganglia are also slightly segmented into four branchial and one intestinal portion, the last two quite inseparable. The cervical plexus, comprising the two occipitals and first three spinal nerves, is in contact with the vagus, but entirely distinct from it.

The eyeball and associated structures in the blind-worms: H. W. NORRIS. (Illustrated with lantern.)

The optical apparatus in the Cœcilians undergoes various degrees of degeneration and transformation, from a condition where the entire mechanism is present, but in a rudimentary condition, to that where only a vestigial eyeball and much modified and transformed retractor and levator bulbi muscle are present.

Bermuda as a type collecting ground for invertebrates: H. A. CROSS, JR.

White grub outbreaks in northeastern Iowa: R. L. WEBSTER.

A brief account of the destructive outbreaks of white grubs in northeastern Iowa in 1912 and 1915; the relation of the contour of the land and the abundance of timber to these outbreaks; the prospects for damage in the near future.

The influence of the male on litter size: EDWARD N. WENTWORTH.

Entomostraca of northwestern Iowa: F. A. STROMSTEN.

The following is a list of Entomostraca collected in the neighborhood of the Macbride Lakeside Laboratory, Lake Okoboji, Iowa, during August, 1916: *Sida crystallina, Daphnia hyalina, Daphnia kahlbergensis, Daphnia Scapholebris mucronata, Simocephalus vetulus, Simocephalus serrulatus, S. americana, Bosmina longirostris, Camptocercus macrurus, Alonella excisa, Pleuroxus stramineus, P. hamatus, P. denticulatus, P. procurvus, Diaptomus sicilis, D. signicauda, D. oregonensis, D. clavipes, D. pallidus, Cyclops signatus* var. *coronatus, C. s.* var. *tenucornis, C. insignis, C. serrulatus, C. macrurus, C. fluviatilis, C. affinis, C. bicolor, C. phaleratus, C. fimbriatus.*

The development of the musk gland in the loggerhead turtle: FRANK A. STROMSTEN.

Some new endoparasites of the snake: THESLE T. JOB.

Porocephalus globicephalus Hett; the characters of the male, which Hett did not have in describing the species, are recorded and additional notes on the habits and anatomy of both sexes offered.

A distome, *Renifer sp?*, closely allied to *R. ellipticus* Pratt. Measurements of the specimens recorded.

Larvæ of Acanthocephalia, *Gigantorynchus sp?*, larval condition described.

Further notes on the venous connections of the lymphatic system in the common rat: THESLE T. JOB.

In addition to the portal, renal and ilio-lumbar vein communications reported in 1915, an inferior vena caval communication at the level of the lumbar nodes has been demonstrated. The variable occurrence of the communications and the lack of correlation of these taps is shown. The possible effect of the physiological condition of the animals and of the injecting technic on the demonstration of the communications is suggested. Conclusions as to the significance of the communications are delayed until the embryological study now in progress is completed.

Mites affecting the poison oak: H. E. EWING.

The Odonata of Iowa: LLOYD WELLS.

Observations on the Protozoa, with descriptions and drawings of some probable new species: CLEMENTINA S. SPENCER.

Notes on some Iowa rodents: DAYTON STONER.

A brief progress report of some work now under

way on the rodents of Iowa for the Iowa Geological Survey. Two forms, *Sciurus hudsonicus minnesota* Allen and *Lepus californicus melanotis* Mearns, are for the first time recorded from Iowa and the known distribution of some other species of rodents is extended. A brief survey of the bounty system in the state is also given.

Botany

The Sand-flora of Iowa: B. Shimek.

Some additional notes on the pollination of red clover: L. H. Pammel and L. A. Kenoyer.

The germination and juvenile forms of some oaks: L. H. Pammel and Charlotte M. King.

Plant studies in Lyon county, Iowa: D. H. Boot.

Notes on Melilotus alba: Walter E. Rogers.

The cleistogamy of Heteranthera dubia: R. B. Wylie.

The influence of soil management on the formation and development of fruit buds: R. S. Kirby.

(*a*) *The white waterlily of Clear Lake, Iowa.* (*b*) *Tree growth in the vicinity of Grinnell, Iowa:* H. S. Conard.

A picea from the glacial drift: Wilbur H. Thomas.

Pioneer plants on a new levee, III.: Frank E. A. Thone.

The morphology of the thallus and cupules of Blasia pusilla: Marguerite B. Rohret.

Chlorotic corn: W. H. Davis.

The æcial stage of alsike clover rust: W. H. Davis.

The rusts on clover were formerly classified as one species until Liro proved the rust on white clover (*T. repens* L.) separate, autœcious and possessing all spore forms. The æcial stage of red clover rust was definitely described by Davis and Johnson at a meeting of the American Association for the Advancement of Science, December, 1916. They showed this rust to be autœcious also, and composed of all spore forms. The disposition of the rust on alsike clover has not been clear; some place it with red clover rust while it is generally regarded as white clover rust. The æcial stage has not been reported in the United States, but has been reported in Germany by Rostrup (1888). The correct determination of his host is not generally accepted.

The use of ferric and ferrous phosphate in nutrient solutions: George E. Corson and Arthur L. Bakke.

A series of experiments have been performed using varying amounts of ferrous and ferric phosphate in Shive's solution as a general basis, in the growth of wheat and Canada field pea seedlings. Ferrous phosphate can not replace the ferric phosphate. The amount as used by Shive has been determined to be the best for the growth of wheat, but for Canada field pea the iron requirement is evidently higher.

Chemistry

(*a*) *Some natural waters of central New York.* (*b*) *Diffusion phenomena of double salts:* Nicholas Knight.

Water-works laboratories: Jack J. Hinman, Jr.

A collection of data from ninety water works laboratories in the United States and Canada, safeguarding an average daily supply of 2,800,000,000 gallons for more than 17,000,000 people. All of these laboratories have been established since 1897. Their organization and methods of chemical and bacteriological control are discussed from the technical standpoint.

Laboratory control is essential to the proper operation of water-works plants which treat a water of variable character.

The free energy of dilution of lithium chloride in aqueous and alcoholic solutions by the electromotive force method: F. S. Mortimer and J. N. Pearce.

The electrical conductivity and viscosity of solutions of silver nitrate in pyridine: H. L. Dunlap and J. N. Pearce.

A study of the relation between solubility, the heat of solution and the properties of the solvent: H. E. Fowler and J. N. Pearce.

The partial analyses of some Iowa clays (preliminary report): J. N. Pearce.

The protein content and microchemical tests of the seeds of some common Iowa weeds: L. H. Pammel and A. W. Dox.

(*a*) *Synthesis of a naphthotetrazine from diethyl succinylosuccinate and dicyandiamide.* (*b*) *The behavior of benzidine toward selenic and telluric acids.* (*c*) *Amino acids and microorganisms:* Arthur W. Dox.

The separation and gravimetric estimation of potassium: S. B. Kuzirian.

The action of the amino group on amylolitic enzymes: E. W. Rockwood.

Some of the factors that influence the extraction of gold from ores by the cyanide process: A. W. Hixson.

James H. Lees,
Secretary